CPS 108, Fall 2005

- **Object oriented programming and design, we'll use Java and C++ (at least)**
  - *Language independent* concepts including design patterns, e.g., Model-View-Controller, iterator, factory, strategy, …
  - *Design independent* concepts, e.g., coupling, cohesion, testing, refactoring, profiling, …
- **Non OO programming and design, we'll use C++ (and its C-subset)**
  - From Java/ArrayList to C++/vector to C/int *
  - From classes to functions, from references to pointers

Goals for students in Compsci 108

- Adept at solving problems requiring programming
  - Design, test, implement, release, revise, maintain
- Reasonably facile with basic Java idioms/libraries
  - How to read the API, knowing what to ignore
  - Basic language features, basic libraries
- Basic knowledge of C++ (and C) programming
  - Beyond the old Compsci 100
  - Java-style use of STL, towards advanced?

More goals for 108 students

- Know patterns catalog, vocabulary and use
  - HFDP rather than GOF (and more TLAs/FLAs)
- Experience working in teams
  - How to accommodate team needs, balance against individual needs (and goals)
- Comfort in working alone, how to get and use help
  - Peers, UTAs, TA, prof, Internet, …

Administrivia

- check website and bulletin board regularly
  - `http://www.cs.duke.edu/courses/cps108/current/`
  - See links to bulletin board and other stuff

- Grading (see web pages)
  - group projects: small, medium, large
  - mastery programs (solo or semi-solo endeavors)
  - readings and summaries
  - tests

Administrivia (continued)

- Evaluating team projects, role of TA, UTA, consultants
  - face-to-face evaluation, early feedback

- Compiling, tools, environments, Linux, Windows, Mac
  - g++ 3.3, 3.4, 4.0?,
  - Java 5 (requires 10.4 on Mac)
  - Eclipse in all environments
  - Command-line tools???

Classes: Review/Overview

- A class encapsulates state and behavior
  - Behavior first when designing a class
  - Information hiding: who knows state/behavior?

- State is private; some behavior is public
  - Private/protected helper functions
  - A class is called an *object factory*, creates lots of instances

How do classes and objects work?

- Classes communicate and collaborate
  - Parameters: send and receive
  - Containment: has a reference to
  - Inheritance: is-a

- Understanding inheritance and interfaces
  - What is polymorphism?
  - When is polymorphism not appropriate?
  - What is an interface in Java, what about C++?

Design Criteria

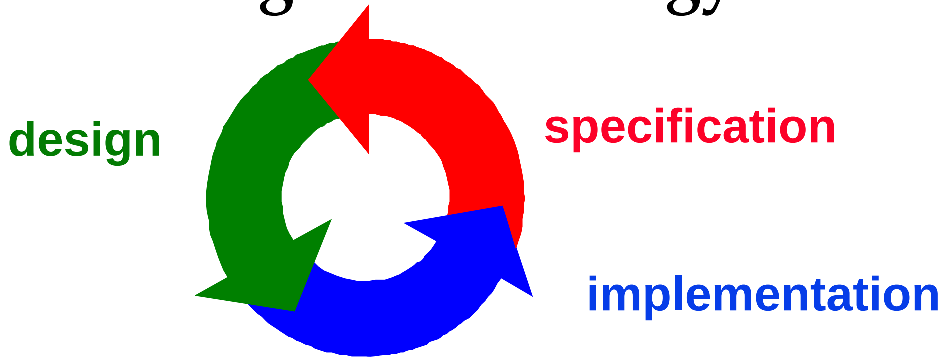
Good design comes from experience, experience comes from bad design

Fred Brooks

- **Design with goals:**
  - ease of use
  - portability
  - ease of re-use
  - efficiency
  - first to market
  - ?????

How to code

- Coding/Implementation goals:
  - Make it run
  - Make it right
  - Make it fast
  - Make it small
- spiral design (or RAD or !waterfall or ...)
  - what's the design methodology?



XP and Refactoring

(See books by Kent Beck (XP) and Martin Fowler (refactoring))

- **eXtreme Programming (XP) is an *agile* design process**
  - **Communication: unit tests, pair programming, estimation**
  - **Simplicity: what is the simplest approach that works?**
  - **Feedback: system and clients; programs and stories**
  - **Courage: throw code away, dare to be great/different**

- **Refactoring**
  - **Change internal structure without changing observable behavior**
  - **Don’t worry (too much) about upfront design**
  - **Simplicity over flexibility (see XP)**

Modules, design, coding, refactor, XP

- Make it run, make it right, make it fast, make it small
- Do the simplest thing that can possibly work (XP)
  - Design so that refactoring is possible
  - Don’t lose sight of where you’re going, keep change in mind, but not as the driving force [it will evolve]

- Refactor: functionality doesn’t change, code does
  - Should mean that new tests aren’t written, just re-run
  - Depends on modularity of code, testing in pieces

- What’s a module in Java?
  - Could be a class, a file, a directory, a package, a jar file
  - We should, at least, use classes and packages

Design Heuristics: class/program/function

(see text by Arthur Riel)

- Coupling
  - classes/modules are independent of each other
  - goal: minimal, loose coupling
  - do classes collaborate and/or communicate?
- Cohesion
  - classes/modules capture one abstraction/model
  - keep things as simple as possible, but no simpler
  - goal: strong cohesion (avoid kitchen sink)
- The open/closed principle
  - classes/programs: open to extensibility, closed to modification

Eric Raymond

- Open source evangelist
  - ➢ The Cathedral and the Bazaar

http://www.catb.org/~esr/writings/cathedral-bazaar/

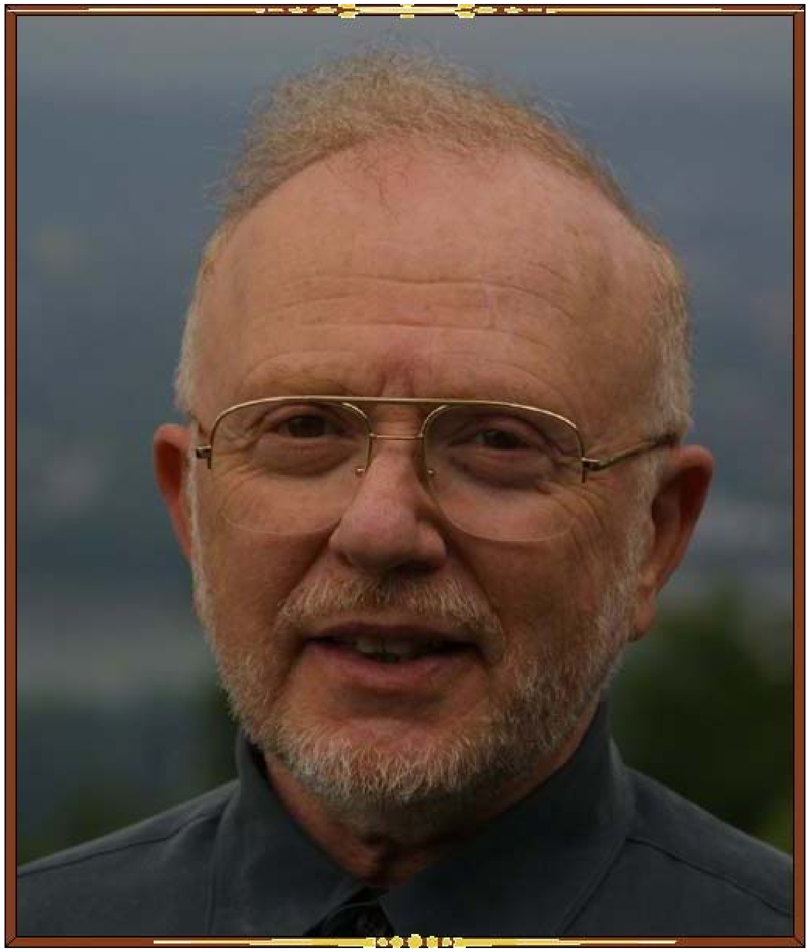
  - ➢ How to construct software

"Good programmers know what to write. Great ones know what to rewrite (and reuse)."

- How to convince someone that guns are a good idea? Put this sign up:

- THIS HOME IS A GUN-FREE ZONE

David Parnas (ACM fellow)



I would advise students to pay more attention to the fundamental ideas rather than the latest technology. The technology will be out-of-date before they graduate. Fundamental ideas never get out of date. However, what worries me about what I just said is that some people would think of Turing machines and Goedel's theorem as fundamentals. I think those things are fundamental but they are also nearly irrelevant. I think there are fundamental design principles, for example structured programming principles, the good ideas in "Object Oriented" programming, etc.